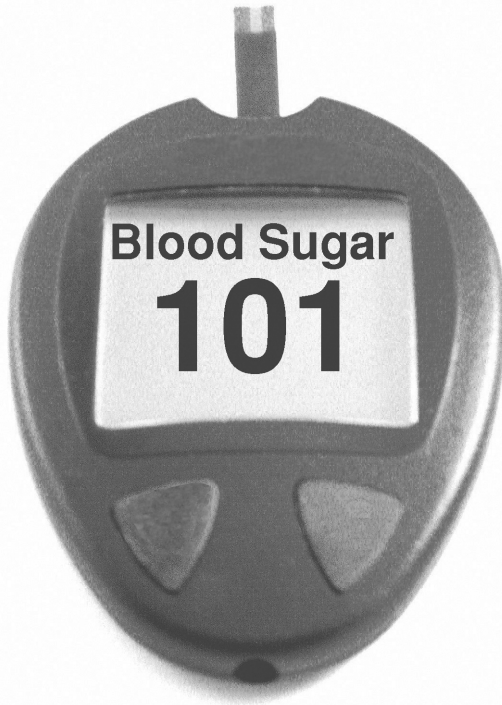


JENNY RUHL



**What They Don't
Tell You
About **Diabetes****

TECHNION Books

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technion@phlaunt.com

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Introduction

Type 2 Diabetes is a terrible disease. It causes impotence, blindness, kidney failure, amputation, and heart attack death.

But Type 2 Diabetes is also a wonderful disease because all these dreadful outcomes are optional. No matter how severe your diabetes might be at diagnosis, it is unique among the serious chronic diseases in that it is the *only* condition where you, the patient, with only a small amount of help from your doctor and no heroic medical interventions can achieve normal health.

This is probably not what you have heard from your doctors. They probably told you it is *normal* for someone with diabetes to suffer foot pain, impotence, slow wound healing, low physical energy, and even a heart attack. So why should you believe me when I tell you it isn't true?

For a very good reason: Over the past decade diabetes treatment has been revolutionized by the emergence of what is often called "The Wisdom of the Web." This term refers to the phenomenon where many thousands of people, each drawing on their own knowledge and experience, create information resources as good or better than those produced by so-called authorities.

Diabetes on the Web

Diabetes was one of the first diseases to benefit from the Wisdom of the Web because people with diabetes have always been expected to do most of the work involved in managing their disease. They've tested their own blood sugar. They've adjusted their own insulin doses. So even before the advent of the Web they had a lot of information about how their blood sugar responded to changes in their diet, medications, and exercise. What they didn't have was any idea of how their own experience might compare with that of others.

With the emergence of the Web, people with diabetes began to talk to each other on newsgroups and discussion forums, they exchanged

information they'd gotten from their solitary testing, they started comparing notes. When they did this, they soon discovered that they weren't the only ones who were having problems with the diets and drug regimens prescribed by doctors and dietitians.

Some people who were active on the Web started trying out alternative diets and drug regimens and reporting their results to each other in the discussion groups. Others started combing through the thousands of peer-reviewed journal articles that had been made available for free on the Web, searching for studies that might point to more effective diabetes treatments. Over time, the information they found and shared started making big improvements in their health.

The 5% Club

Since my own diabetes diagnosis in 1998 I have participated in thousands of Web discussions with hundreds of people with diabetes. Many of them had science or engineering backgrounds like my own.* This gave them a penchant for critical thinking and the skills needed to read and understand journal research. Working together, we learned that it *is* possible for people with diabetes to achieve normal blood sugars. We also uncovered research that suggests that if we maintain truly normal blood sugars we will avoid or even reverse the terrible complications our doctors told us were inevitable.

Some of us call ourselves "The 5% Club" because our goal is to keep our A1c test results under 6%. That is the level most doctors consider to be the normal range. Using a selection of techniques I've learned from participating in Web discussion groups, I've managed to stay in The 5% Club for almost all of the ten years that have followed my diagnosis. Though it has been that long since I was diagnosed, my endocrinologist still refers to me as "recently diagnosed" because she is used to seeing A1cs that low only in people who are new to diabetes.

Why This Book?

Five years ago, after realizing that many people were unaware of the wealth of information to be found in Web discussion groups, I decided to put the most important information on a Web site where people doing Google searches could easily find it. The heart of my Web site was what I learned after spending several months reading through medical

* I'm a software developer.

journals, hunting for studies that answered two questions: “What is a truly normal blood sugar level?” and “What blood sugar levels cause organ damage?” The result was my Web site **Bloodsugar101.com**.

This site is different from most other diabetes Web sites because the information you find on it includes links to studies published in top-rated peer-reviewed medical journals. Visitors to the site don’t have to take anything on trust. They can follow the links and read the research papers themselves. My Web site is also updated any time something significant turns up in the medical news that is relevant to a topic discussed on its pages.

Over the five years of its existence, the site has grown huge. Visitors started asking me if I could put the mass of information stored on the Web site into book form so they could read it more easily. They explained that because the site has grown so large, they could not read the whole thing on the Web and worried that they might be missing out on critical pieces of information buried in its pages.

Since I had already published seven previous books of nonfiction, including a business bestseller, I was excited by the challenge of turning the site into a book. My enthusiasm for the project grew when I began to write it, as I began to see another advantage to putting what I’d written about diabetes into book form: A book is better than a Web site at explaining ideas that can’t be compressed into a few simple paragraphs, because the sequential structure of a book ensures that every concept you encounter in its pages builds on what you have already read. A book is also free of the distractions inherent in the Web’s hypertextual design.

So I hope that this book will add value to the Web site by providing, in a compact and portable form, an orderly examination of the crucial concepts that pervade it. In its pages you will find the explanations that will make you understand, as you never have before, how your blood sugar works, what happens when your blood sugar control breaks down, what blood sugar levels damage your organs, and how you can safely lower your blood sugar enough to prevent any further diabetic complications from occurring.

Every concept presented in the text is backed up by peer-reviewed research papers that were published in highly regarded medical journals. If you want check out this research, you can find the citations in the “References” section at the end of this book. You can find links to these studies and the latest new findings on **Bloodsugar101.com**.

There are some very important issues that people with diabetes must deal with that are not discussed in peer-reviewed research. Here the Wisdom of the Web comes into play, and I draw on the experiences reported by the hundreds of knowledgeable people with diabetes who post messages on the Web. When I cite this type of information, I make it clear that anecdotal reports are its source.

No One Way

Unlike most other diabetes books on the market, this book does not tell you what to eat or what medications to take. If there is one thing we have learned from the Wisdom of the Web, it is that each of us is different and that a strategy that works well for one person may not work for another.

Instead we will teach you how to tell if *any* diabetes strategy you are using is working. By “working” we mean giving you blood sugars low enough to prevent any further organ damage. We’ll show you how to find out if your current diabetes diet is doing the job and, if it isn’t, we’ll show you how to improve it. If you need more than a change of diet to get your blood sugars back into the safe zone, we’ll explore what the diabetes drugs available to you are good for and what their drawbacks are, putting particular emphasis on some cheap but effective diabetes drugs that doctors may overlook because they aren’t being promoted by drug company marketing campaigns.

What’s in it for You?

When you are done reading this book, you will know enough to hold an intelligent conversation with your doctor about your treatment choices. You’ll be better able to evaluate the latest “breakthroughs” you read about in the diabetes news. And most importantly, you’ll have the information you need to keep yourself safe, no matter what current fad is sweeping the medical community. In short, when you are done with this book, you will have the tools you will need to join “The 5% Club” yourself. So welcome aboard!

Chapter One

What is Normal Blood Sugar?

Diabetes is not a disease, it is a symptom.

Everyone diagnosed with any type of diabetes shares a single symptom with every other person with diabetes. That symptom is high blood sugar.

Anything that interferes with the complex mechanisms that the body uses to regulate blood sugar may cause diabetes. It may occur when the cells that secrete insulin get poisoned or die off or when those cells fail to respond to the signals that tell them to make insulin. It may even occur when those cells are making plenty of insulin but insulin receptors in the cells have lost their ability to respond to it. Diabetes can be caused by abnormalities of the adrenal glands or problems with hormones in the gut that inform the body of the presence of food.

It is also possible for one person to have more than one of these metabolic problems at the same time. For example, the most common form of diabetes, which doctors call Type 2 Diabetes, is frequently described as being caused by insulin resistance, the condition where cell receptors stop responding properly to insulin. But scientists have recently discovered that almost one in twelve of those diagnosed with insulin resistant Type 2 Diabetes also have markers in their bloodstream that show they have been the victim of an autoimmune attack that has killed off the cells that make insulin.

What does this mean for you?

Simply this: Though you may have been diagnosed with diabetes, all that your diabetes, my diabetes, and the diabetes of the person sitting across from you at the diabetes support group meeting have in common is that they cause all of us to have abnormally high blood sugars. The cause of our high blood sugars may be different, how high our blood sugars rise after we eat the identical meal may be different, how our bodies respond to the same dose of the same drug may be dramatically different, and, most importantly, what it takes to bring our blood sugars back into the normal range that prevents complica-

tions will be different.

Because we are all so different, the key to recovering good health is to figure out how your own individual version of diabetes works. The first step towards doing this is to learn how blood sugar is regulated in a normal person and how normal blood sugar control breaks down. Armed with this information you will be better able to understand what the various interventions used to treat diabetes do—and which ones might be right for you. So take the time to understand the information you'll find in the next couple pages. It will give you the background you need to take control of your health.

Blood Sugar Control in Normal People

Most of your cells can run on several different kinds of fuel. One of them is a sugar called glucose. It is the sugar we refer to as **blood sugar**. Some glucose always circulates in the bloodstream, where it can be available to any cell that might need it. When you read that your blood sugar is 100 mg/dl, what this is really telling you is that there are 100 milligrams of glucose—one tenth of a gram, in every deciliter of your blood. A deciliter is one tenth of a liter. So if your blood sugar is 100 mg/dl you have 1 gram of glucose in every liter of blood.*

Everywhere except in the U.S., blood sugar is measured using a different measurement of concentration: mmol/L which stands for millimoles per liter. To convert mg/dl into mmol/L you divide mg/dl by 18.05. On Page 174 you will find a table you can use to find the mmol/L equivalent of any blood sugar mentioned in these pages.

Before most cells can use glucose, it must be transported inside the cells. Insulin is the hormone that makes this happen. That is why insulin is so important to blood sugar control. If there is no insulin available, no matter how much glucose is circulating in your bloodstream most of your cells will not be able to use it. And if the sugar in your blood isn't taken into cells, it will build up to dangerously high levels which will damage your organs and can even lead to death.

* All blood sugar meter readings discussed in this book are given as **plasma calibrated** values. Though all meters test only whole blood, plasma calibrated meters adjust the reading to match the value you'd get if you had your blood plasma tested at a lab. All meters currently sold in the U.S. use this kind of calibration. But some older meters and some meters sold in the UK are still **whole blood calibrated**. To convert a whole blood calibrated reading to a plasma calibrated reading, multiply it by 1.12. To convert the blood sugar measurements used here to whole blood calibrated values, divide by 1.12.

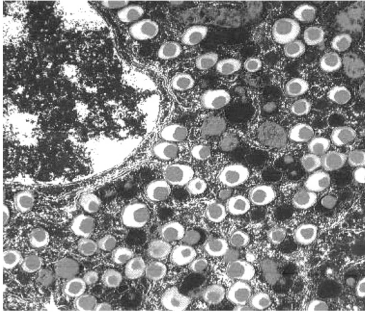


Figure 1. Beta cells in an Islet of Langerhans. The Beta cells in this picture are marked with gray dots

Insulin is produced by special cells called **beta cells**. These tiny cells are found in structures called the Islets of Langerhans which are scattered throughout your pancreas. The pancreas is an organ located near your liver that also secretes digestive enzymes. The job of the beta cell is to manufacture insulin, store it, and release it into the bloodstream when appropriate. Healthy beta cells are continually making insulin and storing it within the beta cell in the form of tiny granules.

The beta cells release this insulin into the bloodstream in two different ways. They release a continuous trickle of what is called **Basal Insulin** throughout the day and they also release larger bursts of insulin after you eat a meal. The meal time releases are called **First- and Second-Phase Insulin Release**.

Basal Insulin Release

The purpose of basal insulin release is to keep a small amount of insulin available in the bloodstream at all times. The beta cells of a healthy person release a small amount of insulin into the bloodstream in small pulses that occur every few minutes throughout the day and night. Maintaining this steady supply of insulin is important. It allows the cells of the body to utilize blood sugar whenever they need it.

During periods between meals the healthy beta cell also manufactures extra insulin and stores it in the form of granules for use at meal time. One of the things scientists have learned recently is that diabetes may develop when something disrupts the timing of this pulsed basal insulin release. Problems with basal insulin production can also keep the beta cells from storing the granules of insulin that will be used at meal times.

When you test your **fasting blood sugar** after not eating for eight hours or more, you are examining the health of your ability to secrete basal insulin. A normal or near normal fasting blood sugar means that your ability to secrete basal insulin is still intact. Truly normal fasting blood sugar values fall in the range between 70 and 85 mg/dl. Doctors

will tell you that the normal range for a fasting blood sugar extends up to 100 mg/dl, but quite a lot of research has shown that people whose fasting blood sugar is over 90 mg/dl are very likely to develop diabetes within a decade, which suggests that it is not truly normal.

Insulin Levels Signal the Liver Whether More Glucose is Needed

The liver is the organ whose job is to add glucose to the blood stream if the blood sugar level starts to drop too low. If basal insulin production is working properly, the steady level of insulin in the bloodstream sends the signal to the liver that all is well and that no more glucose is needed. But if the insulin level drops during a fasting period, or if the liver becomes insulin resistant and does not respond to insulin signaling, the liver will assume that the glucose in the bloodstream is getting used up and more glucose is needed.

When the liver gets the signal that more glucose is needed, it turns to some carbohydrate it has stored for just this purpose. The term **carbohydrate** refers to the nutrients we call sugars and starches. The liver stores carbohydrate in the form of a substance called **glycogen**. To raise the blood sugar, the liver converts this glycogen into glucose and then dumps the resulting glucose into the bloodstream. This raises the blood sugar back to its normal level and ensures that cells will continue to have the fuel they need.

If it doesn't have enough glycogen stored, the liver can convert protein into glucose, too, and it will do this using protein from the food you have recently eaten. If you aren't eating enough protein, the body will break down the protein stored in your muscles, to provide the glucose the body needs.*

First-Phase Insulin Release

As soon as a healthy person starts to eat a meal, the parasympathetic nervous system sends out signals that begin the process that causes beta cells to release insulin into the bloodstream, beginning with the insulin they previously stored in granules.

As soon as the food hits the stomach, the carbohydrates in that food start to digest. Any pure glucose you have eaten goes immediately into the blood stream as it doesn't need to be broken down any further.

* This ability of the liver to turn muscle into glucose is why dieters lose muscle mass if they don't get enough protein when they are on stringent diets.

Fructose gets whisked away to your liver which converts it into fat. Digestive enzymes break down the rest of the carbohydrates in your meal into the two simple sugars, glucose and fructose, and that glucose goes into your bloodstream, too. It takes no more than 15 minutes after you have eaten a meal containing sugar or starch for the first glucose from the digested food to reach the bloodstream and begin raising the concentration of glucose in your blood.

Rising blood sugars now stimulate the beta cells to secrete more insulin. At the same time, as blood sugars rise to a threshold—somewhere between 100 and 120 mg/dl—**incretin hormones** released by the gut also stimulate the beta cells to secrete insulin. These early releases of insulin that occur as soon as you begin eating a meal are called **first-phase insulin release**. In a healthy person first-phase insulin release keeps the blood sugar from rising much over 125 mg/dl.

What cells take up that glucose? The brain and muscles have first dibs. Then the liver will use some glucose to top off its store of glycogen. But if your brain and muscle cells are all set for glucose and your liver has enough glycogen, insulin pushes glucose into *fat* cells. Insulin plays an important part in the process that transforms glucose into fat.

The amount of insulin a normal person's beta cells secrete during this first-phase insulin release is believed to be very close to the amount they needed to process the glucose produced by previous meals. If they usually eat a lot of carbohydrate, their body will release more insulin at the start of the next meal, even if that meal doesn't contain much carbohydrate. If this large dose of first-phase insulin doesn't meet up with enough incoming carbohydrate, it may drive the normal person's blood sugar low. When blood sugar drops too low, the brain senses it and sends out hunger signals that ramp up carbohydrate cravings. This is suggested as a reason why people with normal or near-normal metabolisms who have been eating a lot of carbohydrate may find themselves craving carbohydrates if they try to cut down on their carbohydrate intake.

If the normal person doesn't respond to the low blood sugar attack by eating more carbohydrate, their liver will transform stored glycogen into glucose and release that glucose into the blood stream until it has raised the blood sugar back to a normal level. When that person eats the next meal after the meal that resulted in a low blood sugar, their beta cells will release less first-phase insulin and avoid causing another low blood sugar.